

U.S. Patent Application of BEASE et al., Appln. No. 10/644,957

**REMARKS**

Claims 1, 10, 15, and 16 are amended by hereby. No claims are canceled or added. Accordingly, claims 1-36 remain pending. Claims 17-36 are withdrawn from consideration.

In the Final Office Action dated September 20, 2005, the Examiner rejected claims 1-4, 6-10, 15, and 16 under 35 U.S.C. § 102(e) as anticipated by Yu et al. (U.S. Patent No. 6,818,553). Claim 5 was rejected under 35 U.S.C. § 103(a) as unpatentable over Yu et al. in view of Yang et al. (U.S. Patent No. 6,579,809). In addition, the Examiner rejected claims 11, 12, and 14 under 35 U.S.C. § 103(a) as unpatentable over Yu et al. in view of Ranft et al. (U.S. Patent No. 6,536,449). Claim 13 was rejected under 35 U.S.C. § 103(a) as unpatentable over Yu et al. in view of Otsuki (U.S. Patent Application Publication No. 2001/0003271). Finally, claims 1-16 were provisionally rejected under the judicially-created doctrine of obviousness-type double patenting in view of claims 93 and 95-104 of co-pending application serial number 10/670,795 in view of Yu et al., Ranft et al., and Otsuki. The Applicant respectfully disagrees with each of these rejections and, therefore, respectfully traverses the same.

Claims 1-16 are patentably distinguishable over the references cited by the Examiner because each of the claims now recite that the high-permittivity material is substantially free of Si. None of the references describe or suggest an apparatus or a method that combines features with at least this feature. Accordingly, the Applicant respectfully submits that the references relied upon by the Examiner may not be combined in the manner suggested. As a result, the Applicant respectfully submits that claims 1-16 are patentable and should be passed quickly to issue.

Yu et al. fails to anticipate or assist in rendering obvious claims 1-16 for at least two reasons. First, Yu et al. does not describe etching of any high-k materials that are substantially free of Si. Second, since all of the high-k materials discussed by Yu et al. include Si, it may be said that the reference teaches away from claims 1-16.

Yu et al. describes an etching process to be performed on a high-k gate dielectric layer 14, which is preferably comprised of ZrSiO<sub>4</sub>, HfSiO<sub>4</sub>, LaSiO<sub>4</sub>, YSiO<sub>4</sub>, ZrSi<sub>x</sub>O<sub>y</sub>, or Hf Si<sub>x</sub>O<sub>y</sub>. (Yu et al. at col. 2, lines 24-29.) As is immediately apparent, each of the high-k materials listed include Si. Since each of claims 1-16 require that the high-permittivity material be substantially free of Si, Yu et al. does not anticipate

U.S. Patent Application of BEASE et al., Appln. No. 10/644,957

any of claims 1-16. Moreover, since Yu et al. is directed to etching of high-k materials that include Si, the Applicant respectfully submits that Yu et al. may not be relied upon in combination with the remaining references to render obvious any of claims 1-16. Those of ordinary skill in the art simply would not think to look to a reference concerning Si-containing materials for any teaching that may be applied to materials substantially free of Si.

Yang et al. describes an in-situ gate etch process for fabrication of a narrow gate transistor structure with a high-k dielectric. In the exemplary embodiment, the high-k dielectric material forms the etch stop layer 62. (Yang et al. at col. 5, lines 5-9.) The high-k dielectric material 62 is removed using an etch chemistry of HBr, He, or CF<sub>4</sub>. (Yang et al. at col. 7, lines 20-27.) While Yang et al. does list high-k materials such as HfO<sub>2</sub>, ZrO<sub>2</sub>, CeO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, TiO<sub>2</sub>, and Y<sub>2</sub>O<sub>3</sub>, Yang et al. does not describe or suggest modifying the layer containing the high-permittivity material by exposing the layer to a plasma nor does it describe removing the modified layer. (See, e.g., Yang et al. at col. 4, lines 39-43.) Accordingly, the Applicant respectfully submits that Yang et al. cannot be combined properly with Yu et al. to render any of the claims obvious. As a result, the Applicant respectfully requests that the Examiner withdraw the rejection.

Ranft et al. also does not assist the Examiner in fashioning a rejection of the claims. Ranft et al. describes a downstream surface cleaning process. Ranft et al. does not describe or suggest modifying the layer containing the high-permittivity material by exposing the layer to a plasma nor does it describe removing the modified layer. Accordingly, the Applicant respectfully submits that Ranft et al. cannot be combined properly with any of the remaining references to render any of the claims obvious. As a result, the Applicant respectfully requests that the Examiner withdraw the rejection.

Otsuki also does not assist the Examiner in fashioning a rejection of the claims. Otsuki describes a processing apparatus with a chamber having therein a high-corrosion-resistant sprayed film. Otsuki does not describe or suggest modifying the layer containing the high-permittivity material by exposing the layer to a plasma nor does it describe removing the modified layer. Accordingly, the Applicant respectfully submits that Otsuki cannot be combined properly with any of the

U.S. Patent Application of BEASE et al., Appln. No. 10/644,957

remaining references to render any of the claims obvious. As a result, the Applicant respectfully requests that the Examiner withdraw the rejection.

With respect to the Examiner's assertion of an obviousness-type double patenting rejection, the Applicant respectfully requests that the rejection be withdrawn. Claims 93 and 95-104 from the co-pending application are reproduced below:

93. A method of processing a layer containing a high-permittivity material, the method comprising:  
modifying a layer containing a high-permittivity material by exposing the layer to a first process gas in a plasma; and  
etching the modified high-permittivity layer in the absence of a plasma by exposing the layer to a second process gas comprising an etch reactant.
94. The method according to claim 93, wherein the layer containing a high-permittivity material overlies another layer in a substrate.
95. The method according to claim 94, further comprising providing the substrate in a process chamber.
96. The method as claimed in claim 93, wherein the modifying step partially removes the layer containing the high-permittivity material.
97. The method as claimed in claim 93, wherein the modifying step partially disassociates the layer containing the high-permittivity material.
98. The method according to claim 93, wherein the first process gas comprises a reactive gas.
99. The method according to claim 96, wherein the reactive gas comprises at least one of HBr and HCl.
100. The method according to claim 98, wherein the first process gas further comprises an inert gas.
101. The method according to claim 100, wherein the inert gas is selected from He, Ne, Ar, Kr, Xe, and N<sub>2</sub>, or mixtures thereof.
102. The method according to claim 93, wherein the first process gas comprises an inert gas.

## U.S. Patent Application of BEASE et al., Appln. No. 10/644,957

103. The method according to claim 102, wherein the inert gas comprises at least one of He, Ne, Ar, Kr, Xe, and N<sub>2</sub>.

104. The method according to claim 93, wherein the high-permittivity material comprises at least one of Ta<sub>2</sub>O<sub>5</sub>, TiO<sub>2</sub>, ZrO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, HfSiO, and HfO<sub>2</sub>.

Claims 94-104 depend from claim 93. As claim 93 makes apparent, the claims require etching the modified high-permittivity layer in the absence of a plasma by exposing the layer to a second process gas comprising an etch reactant. Use of a second process gas for etching is quite different from wet etching, which is required by claims 1-16 in the present application. As a result, the Applicant respectfully submits that claims 1-16 are not obvious in view of claims 93 and 95-104 in the co-pending application. Accordingly, the Applicant respectfully requests that the Examiner withdraw the provisional obviousness-type double-patenting rejection.

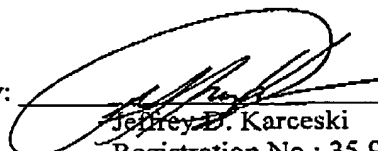
Each of the rejections asserted by the Examiner having been addressed, the Applicant respectfully submits that claims 1-16 are patentable over the references cited by the Examiner. Accordingly, the Applicant respectfully requests that the Examiner withdraw the rejections asserted against claims 1-16 and pass this application quickly to issue.

If the Examiner believes a telephone conference would be helpful, she is invited to contact the undersigned at the telephone number given below.

Respectfully submitted,

PILLSBURY WINTHROP SHAW PITTMAN LLP

By:

  
Jeffrey D. Karceski  
Registration No.: 35,914

P.O. Box 10500  
McLean, Virginia 22102  
(703) 905-2110  
(703) 905-2500 Facsimile

Customer No. 00909